Remarks:

The Applicant would like to thank the Examiner for carefully reviewing the specification and claims. Please reconsider the application in view of the following remarks.

1. Status of the Claims

Claims 1-43 are pending in the application. Claims 1, 12, 23 and 33 are independent. Claims 1, 6-9, 12, 17-20, 23 and 33 stand rejected as anticipated Van Yperen (U.S. Pat. No. 5,402,787). Claims 10-11, 21, 22, 27-29, 37-39 and 43 stand rejected as obvious over Van Yperen alone. Claims 2-5, 13-16, 24-26, 30-32, 34-36, and 40-42 stand rejected as obvious over Van Yperen in view of secondary references.

2. Claim rejections - 35 U.S.C. § 102(b)

Independent claims 1, 12, 23 and 33 stand rejected as anticipated by Van Yperen. The Applicant respectfully traverses the rejection for the following reasons.

Claim 1 recites a method for measuring whole body composition. The method includes inducing static and radio frequency magnetic fields in a volume. The body is disposed within the volume. NMR signals are detected from within the body. In the invention of claim 1, the static and radio frequency magnetic fields are arranged such that the NMR signals from any part of the body are substantially independent of the position of the body within the volume. The composition of the whole body is determined from the NMR signals. Understanding the underlined portion of claim 1 is essential to understanding the difference between the claimed invention and what is disclosed in Van Yperen. In the Applicant's invention, the static and radio frequency magnetic fields are arranged in a manner such that nuclear magnetization and the concomitant NMR signals are substantially independent of the body position within the volume. In this way the claimed result of the invention, namely that the NMR signals from any part of the body are substantially independent of the position within the volume can be achieved. The Applicant has disclosed arrangements of magnet and antenna that are capable of inducing the claimed field configuration. The Applicant has determined that it is possible to obtain precise, quantitative

NMR analysis of the composition of a body which may move (change position during or between measurements) within the examination volume.

Van Yperen shows a conventional NMR imaging system. In any NMR imaging system the body to be imaged has to remain still during the measurement, in contrast to the Applicant's invention where the body can move within the volume without any restrictions during the measurement. Moreover, if the body changes position between two measurements, conventional NMR imaging according to Van Yperen will generate two different images reflecting two different body positions. In contrast, two measurements according to the Applicant's invention will generate the same result. The result is the composition of the whole body. Specifically, the result may include total body fat content and/or total body lean tissue content.

NMR imaging systems such as the one shown in Van Yperen include a magnet for inducing a static magnetic field, and antennas for inducing radio frequency magnetic fields in a patient disposed in an examination volume. However, NMR imaging systems also include gradient magnetic field inducing devices for superimposing gradient magnetic fields on the static magnetic field. The gradient fields are arranged in three orthogonal directions such that each point in space within the examination volume is associated with a unique value of static magnetic field. Each point in space is thus associated with a unique NMR frequency. Thus, the NMR signal from every point in space is uniquely associated with a particular NMR frequency. The NMR signal amplitude from each point in space is mapped to an imaging device, such as photographic or video gray scale, to generate images of the interior of the patient. What should be apparent to the Examiner at this point is that in NMR imaging devices, and the one shown in Van Yperen is no exception, the NMR signal from each part of the body is most definitely not independent of the position of the body part within the volume. Accordingly, one affirmative limitation of claim 1 is not shown in Van Yperen.

As another matter, "determining composition" as used in the Applicant's claims is clearly intended to mean quantitatively determining amounts of one or more constituent substances present within the body portion. Numerous references in the Applicant's specification

concerning the analysis performed using the NMR measurements make this definition quite clear. Prior art NMR imaging techniques, including the one shown in Van Yperen, do not include quantitative determination of constituent substances from within the particular investigated volume. In NMR imaging techniques known in the art, a body being examined is segmented into relatively small image volumes, called "voxels", that are individually investigated, and for each of which a set of signal amplitude values are assigned. The set of signal amplitude values may be derived from various attributes of spin echo amplitudes in a spin echo measurement sequence (such as CPMG) measured for each voxel. Nonetheless, each voxel has associated with it only one final set of measurement values, and as explained above, such values may be used to generate an image. In generating a complete image of all or a portion of the body being analyzed, the discrete voxel values are applied in some form of display, usually a gray scale visual image representation. Composition of the entire body or part thereof may be inferred by summing the numbers of individual voxels for which the amplitude is a certain value or certain values. For example, bone tissue may be inferred when the signal amplitude is a preselected fraction of maximum possible signal amplitude in each voxel. The number of voxels over the entire body image represented by bone signal amplitude is then determined, and a fractional volume of bone tissue in the entire body may be determined by dividing the number of bone-containing voxels by the total number of voxels in the imaged body.

The foregoing explanation of prior art image analysis is well described in the Applicant's Background of the Invention portion of the present application.

The Applicant's claimed invention is quite different in that whole body compositions is determined from the detected nuclear magnetic resonance signals in the entire body. In the Applicant's claimed invention, the whole body itself constitutes an individual voxel in an image. The composition is determined quantitatively from the signals measured entirely within the individual voxel. Such determination of composition is simply not disclosed in the prior art. The Applicant has outlined numerous possible advantages of using such measurement technique, including that by measuring NMR signals over a sufficiently large volume, it is possible to have substantial signal to noise ratio using relatively low static magnetic field strength. As

importantly, by analyzing whole body composition in one image voxel, a body composition analysis may be performed in much shorter time than by conventional image integration. Additionally, because the composition is determined only from the NMR signals in whole body, it is not necessary to determine the body volume to determine fractional constituent amounts, as with prior art imaging techniques. Further, certain attributes of the NMR signals acquired and processed according to the invention may be used to directly determine mass of one or more constituents of the whole body. Such is not possible with prior art imaging techniques, which can only provide information about volume fraction of constituents inferred from image amplitudes in each pixel.

To summarize, the prior art of record does not show determining whole body composition using NMR signals from the whole body. Accordingly, claim 1 cannot be anticipated by Van Yperen.

Claims 2-11 ultimately depend from claim 1 and are believed to be patentable for at least the same reasons advanced with respect to claim 1.

Claim 12 also recites assessing whole body composition using NMR signals induced within the entire body. Claim 12 includes that spatial distribution of the static and radio frequency magnetic fields are selected to minimize an objective function. The objective function is related to degree of precision required of the measurement and at least one parameter related to cost of implementing the method, for example, size of the magnet. The Applicant has determined, as explained above with respect to claim1, that it is feasible to assess whole body composition by inducing substantially homogeneous static and RF magnetic fields in the entire body, and assessing composition of the entire body from those signals. Such method elements are clearly not shown in Van Yperen. Further, there is nothing in VanYperen related to selecting parameters of cost to implement and required degree of measurement precision to minimize and objective function. Accordingly, claim 12 cannot be anticipated by Van Yperen. A possible benefit of the method of claim 12 is to minimize the cost of the apparatus needed to make the measurements with a selected degree of precision.

Claims 13-22 ultimately depend from claim 12 and are believed to be patentable for at least the same reasons advanced with respect to claim 12.

Claim 23 recites a nuclear magnetic resonance apparatus configured to perform the method substantially as recited in claim 1. In particular, claim 23 includes a means for analyzing composition of a body from NMR signals detected from within the body. Analyzing composition, as that term is used in the Applicant's invention, is not disclosed in Van Yperen. Further, Van Yperen does not disclose a magnet configured to provide a minimum static magnetic field amplitude (strength) with respect to a required degree of precision of measurement. The magnet disclosed in Van Yperen is a conventional one as used with NMR imaging. The static field amplitude is not minimized in such magnets, but rather is selected to provide sufficient spatial resolution when combined with the gradient fields to identify signals from individual image voxels. Accordingly, claim 23 cannot be anticipated by Van Yperen.

Claims 24-32 ultimately depend from claim 23 and are believed to be patentable for at least the same reasons advanced with respect to claim 23.

Claim 33 recites a nuclear magnetic resonance apparatus for body composition analysis in which the magnet and antenna are arranged to induce substantially uniform magnetization within an examination volume. Van Yperen, as previously explained, discloses a conventional NMR imaging device in which the magnet and antenna have no such limitations. Further, claim 33 recites that a size of the examination volume is maximized with respect to the size of the magnet and antenna for a selected degree of precision of measurement. No such limitations are disclosed in Van Yperen. Accordingly, claim 33 cannot be anticipated by Van Yperen.

Claims 34-43 ultimately depend from claim 33 and are believed to be patentable for at least the same reasons advanced with respect to claim 33.

This Reply is believed to be fully responsive to each and every ground of rejection cited in the Office Action of August 8, 2006, and the Applicant respectfully requests early favorable action on this application.

Respectfully submitted,

Date: 8/22/2006

Richard A. Fagin, Reg. No. 39,182
P.O. Box 1247
Richmond, TX 77406-1247

Telephone: (713) 539-5006
Facsimile: (832) 595-0133